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AIR FORCE SPACE MISSION REQUIREMENTS

1. RECONNAISSANCE
2. COMMUNICATIONS
3. MANNED SPACE FLIGHT
4. TECHNICAL DEVELOPMENT AND EXPERIMENTAL SUPPORT

DOWNGRADED AT 12 YEAR
INTERVALS; NOT AUTOMATICALLY
DECLASSIFIED. DOD DIR 5200.10

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VEHICLE COMBINATIONS APPLICABLE TO RECOMMENDED MISSIONS

1. RECONNAISSANCE - (117L)

THOR + VANGUARD (EARLY EXPERIMENTAL FLIGHTS)
ATLAS + YLR-81

2. COMMUNICATIONS

THOR + 15,000 LB. F_2 STAGE
TITAN 1st STAGE + TITAN 2nd STAGE + 15,000 LB. F_2 STAGE
TITAN 1st STAGE + 110,000 LB. F_2 + 15,000 LB. F_2

3. MANNED SPACE FLIGHT

THOR + VANGUARD (ANIMAL EXPERIMENTS; DATA GATHERING)
TITAN 1st STAGE + TITAN 2nd STAGE + 15,000 LB. F_2
TITAN 1st STAGE + 110,000 LB. F_2 + 15,000 LB. F_2

4. TECHNICAL DEVELOPMENT & EXPERIMENTAL SUPPORT

ALL VEHICLES APPLICABLE AS DICTATED BY PAYLOAD REQUIREMENTS

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DOWNGRADED AT 12 YEAR
INTERVALS; NOT AUTOMATICALLY
DECLASSIFIED. DOD DIR 5200.10

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PRIMARY VEHICLE COMBINATIONS RECOMMENDED

1. THOR + VANGUARD 2ND STAGE + VANGUARD 3RD STAGE
2. THOR + 15,000# F_2 STAGE
3. TITAN 1ST STAGE + TITAN 2ND STAGE + 15,000# F_2 STAGE
4. TITAN 1ST STAGE + 110,000# F_2 STAGE + 15,000# F_2 STAGE
5. ATLAS + YLR-81 (PRESENT 117L)
6. NEW VEHICLE FOR SECOND GENERATION SPACE WEAPON
   (CHEMICAL OR NUCLEAR DECISION BY 1959/60)

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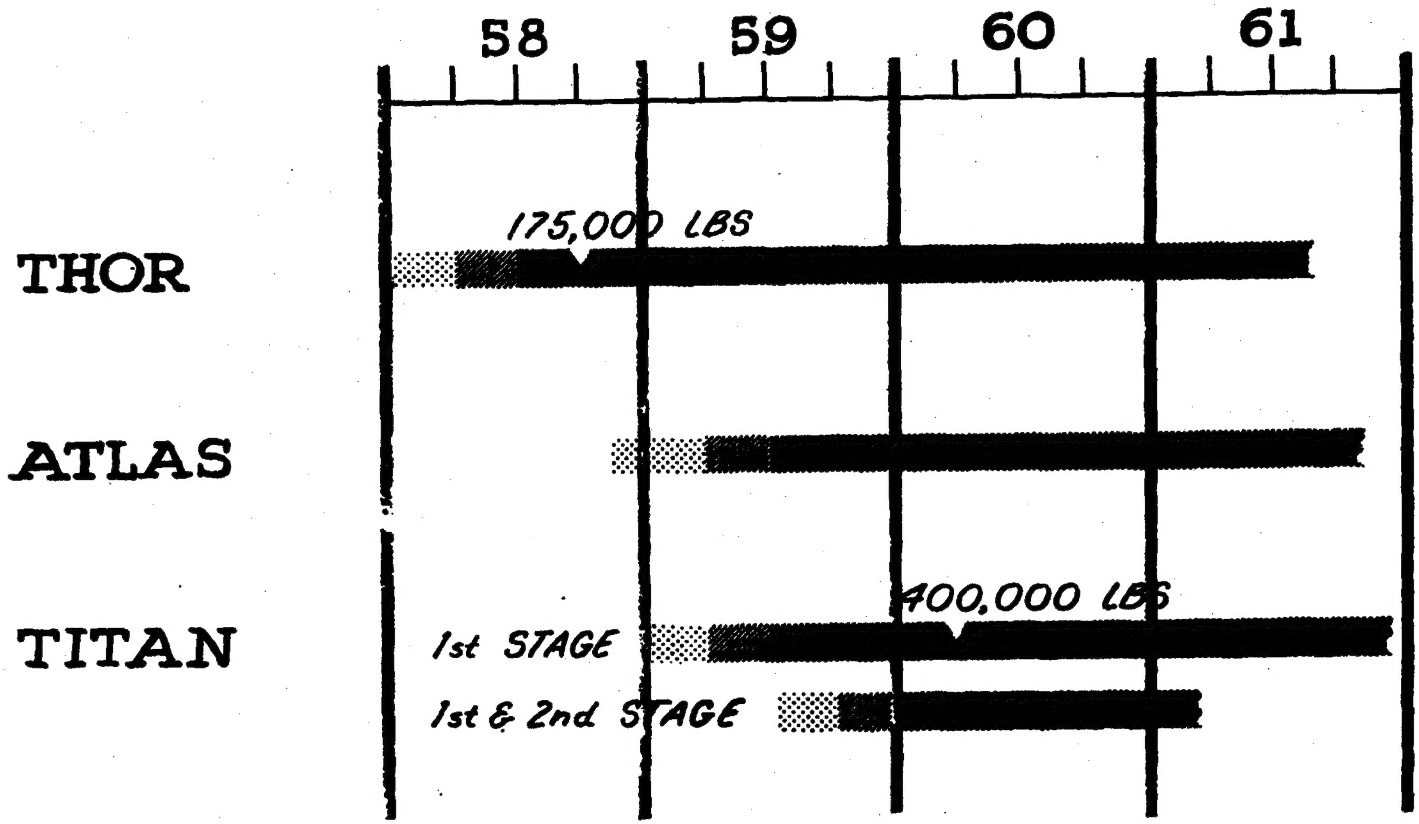
BOOSTER AVAILABILITY



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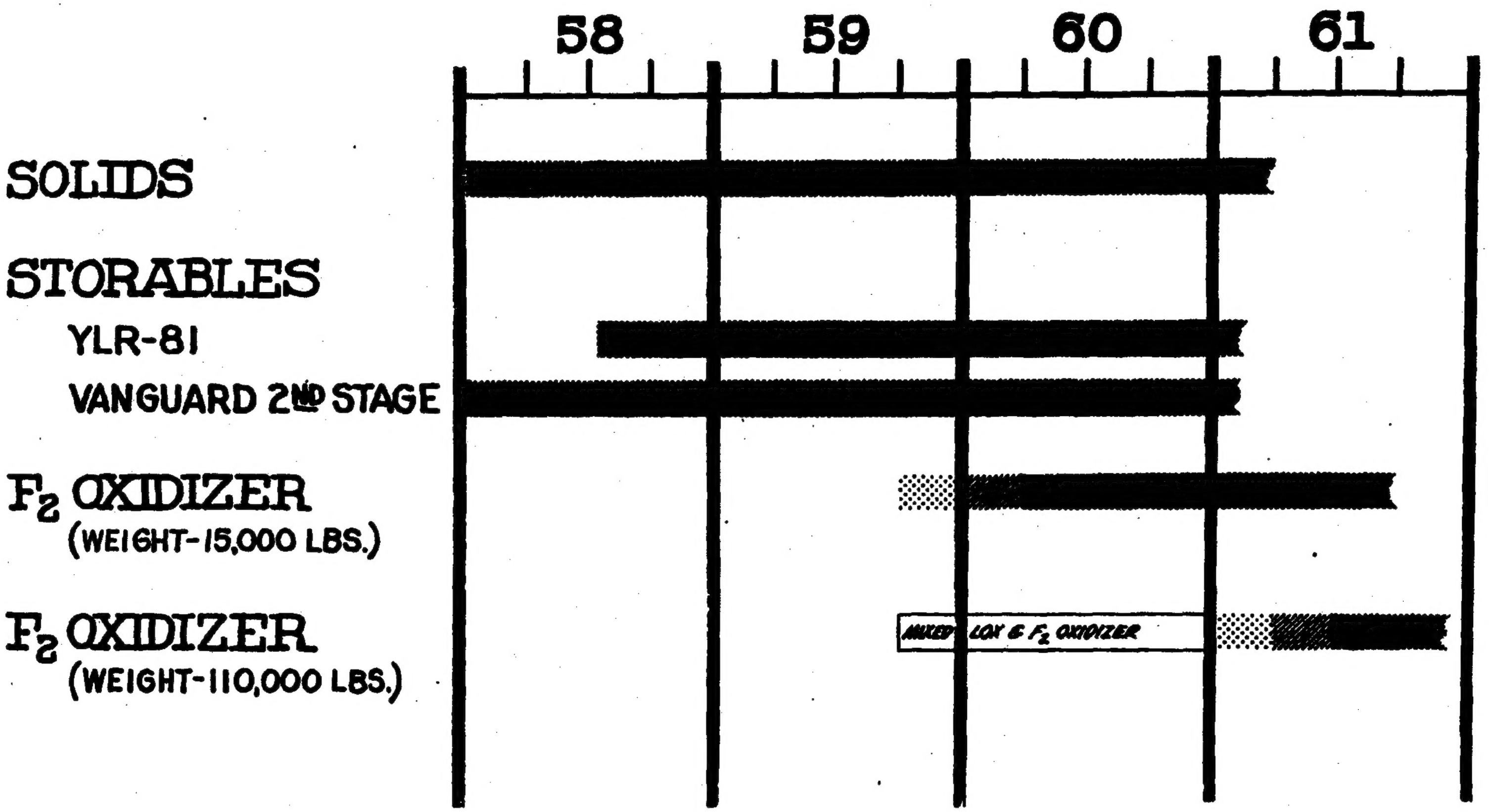
AVAILABILITY OF ADDED STAGES RECOMMENDED AS "BUILDING BLOCKS"



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GENERAL CONCLUSIONS

1- PRESENT ATLAS, TITAN, AND THOR PROVIDE BOOSTER CAPACITY FOR SPACE MISSIONS OF PRIMARY INTEREST FOR NEXT 10 YEARS. PRINCIPAL INVESTMENT IN FIRST GENERATION SPACE VEHICLES ALREADY MADE.

2- DEVELOPMENT OF A FEW ADDED STAGES OF SMALL SIZE AS "BUILDING BLOCKS" CAN PROVIDE, IN PROPER COMBINATION WITH THE BOOSTERS, VEHICLES FOR ALL SPACE MISSIONS FOR THE NEXT 10 YEARS.

3- THE GUIDANCE SYSTEMS FOR PRESENT AND SECOND GENERATION ICBM AND IRBM ARE BASICALLY ADEQUATE TO PERFORM THE SPACE MISSIONS.

4- DEVELOPMENT OF "PAYLOADS" FOR SOME OF THE VARIOUS MISSIONS (INCLUDING "PAYLOADS" FOR ANIMAL AND MANNED EXPERIMENTS) CAN BE DEFINED AND INITIATED NOW.

5- RESEARCH AND TECHNICAL DEVELOPMENT REQUIRED ON CRITICAL PROBLEMS AND ON BASIC SPACE PHENOMENA CAN BE DEFINED AND INITIATED NOW FOR THE SECOND GENERATION OF SPACE VEHICLES AND SPACE MISSIONS.

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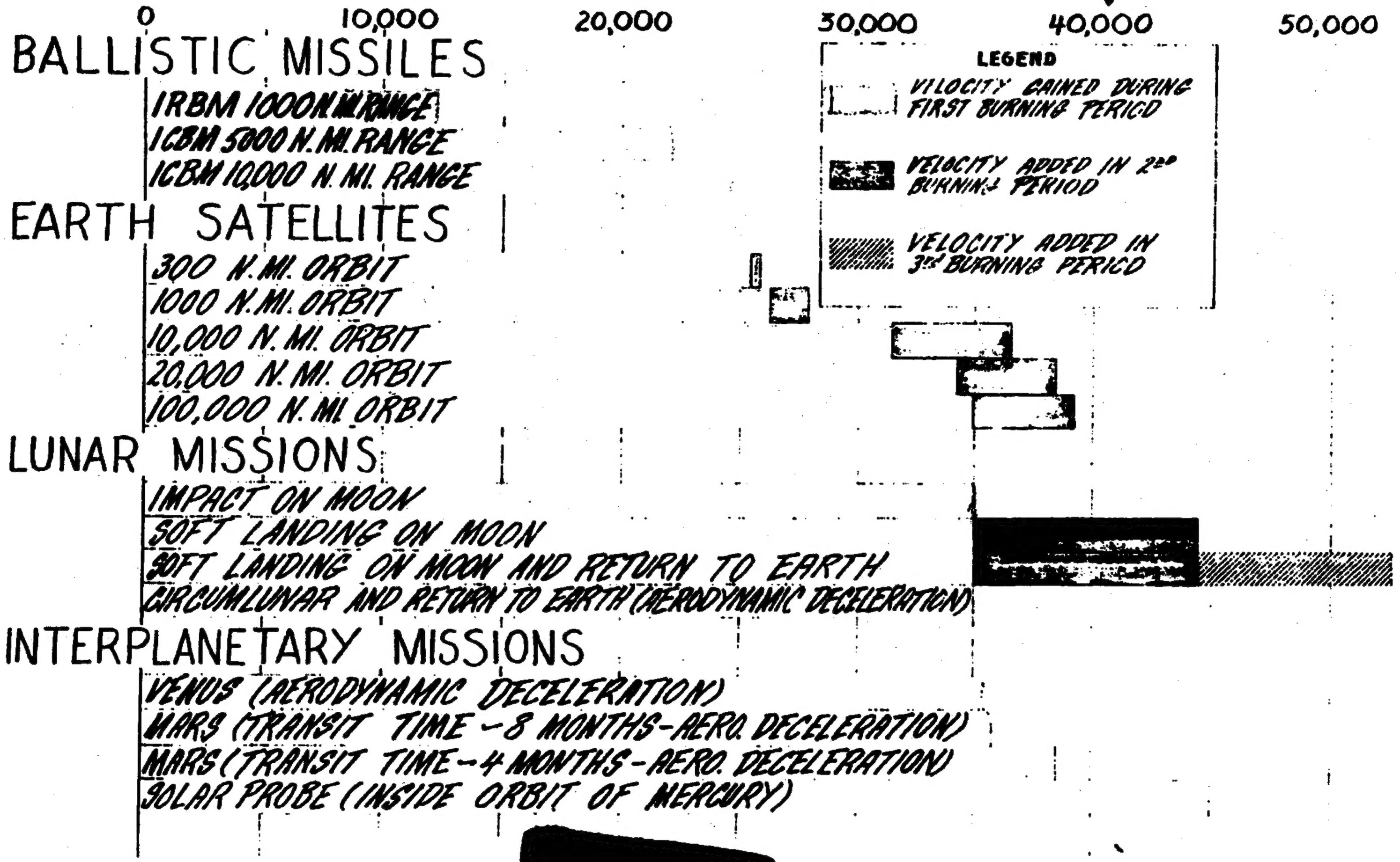
EQUIVALENT VELOCITY REQUIRED FOR VARIOUS MISSIONS-FT/SEC.



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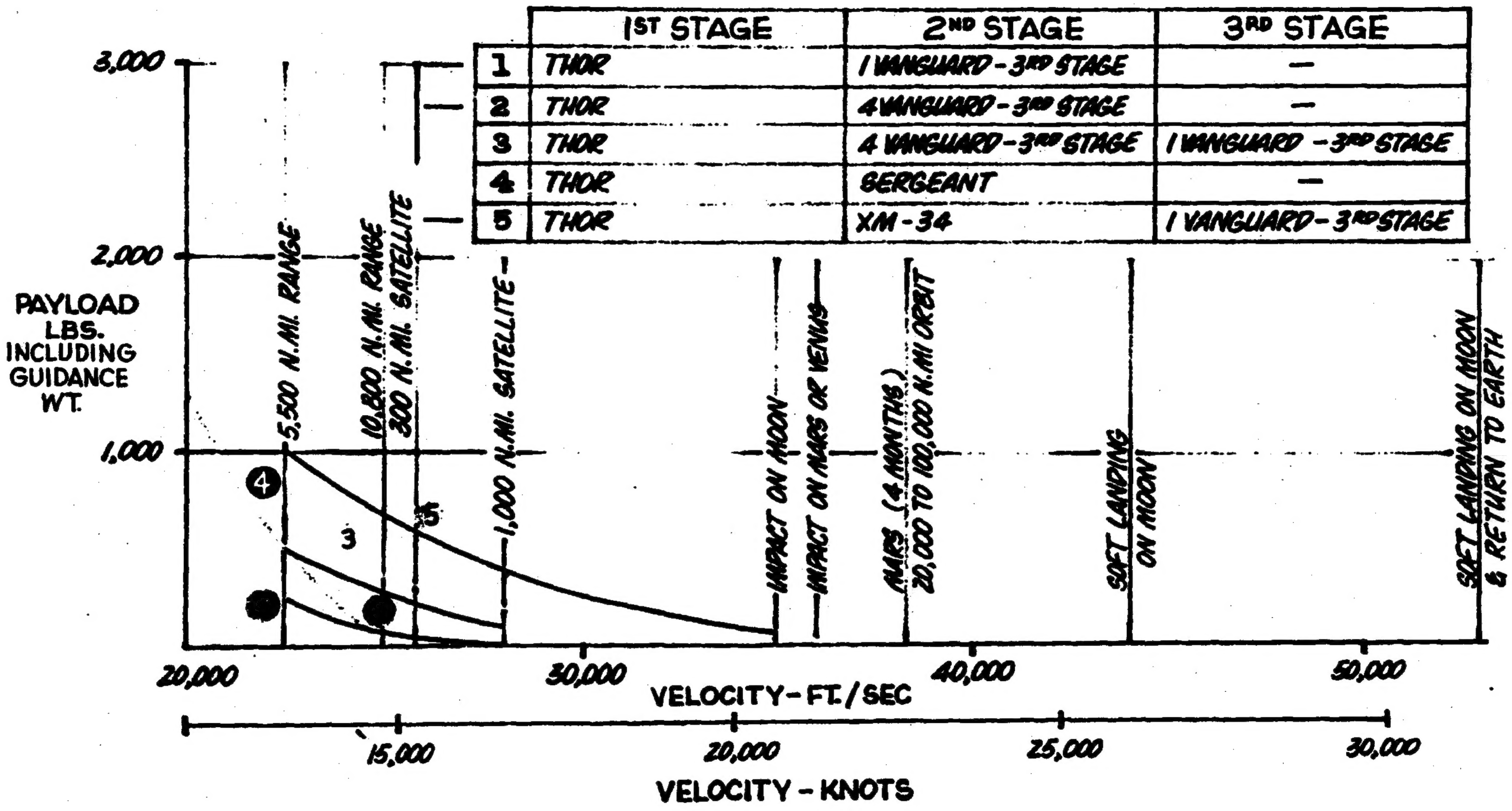
THOR CAPABILITY WITH ADDED STAGES
(OF SOLID PROPELLANT)



	1ST STAGE	2ND STAGE	3RD STAGE
1	THOR	1 VANGUARD - 3RD STAGE	—
2	THOR	4 VANGUARD - 3RD STAGE	—
3	THOR	4 VANGUARD - 3RD STAGE	1 VANGUARD - 3RD STAGE
4	THOR	SERGEANT	—
5	THOR	XM - 34	1 VANGUARD - 3RD STAGE

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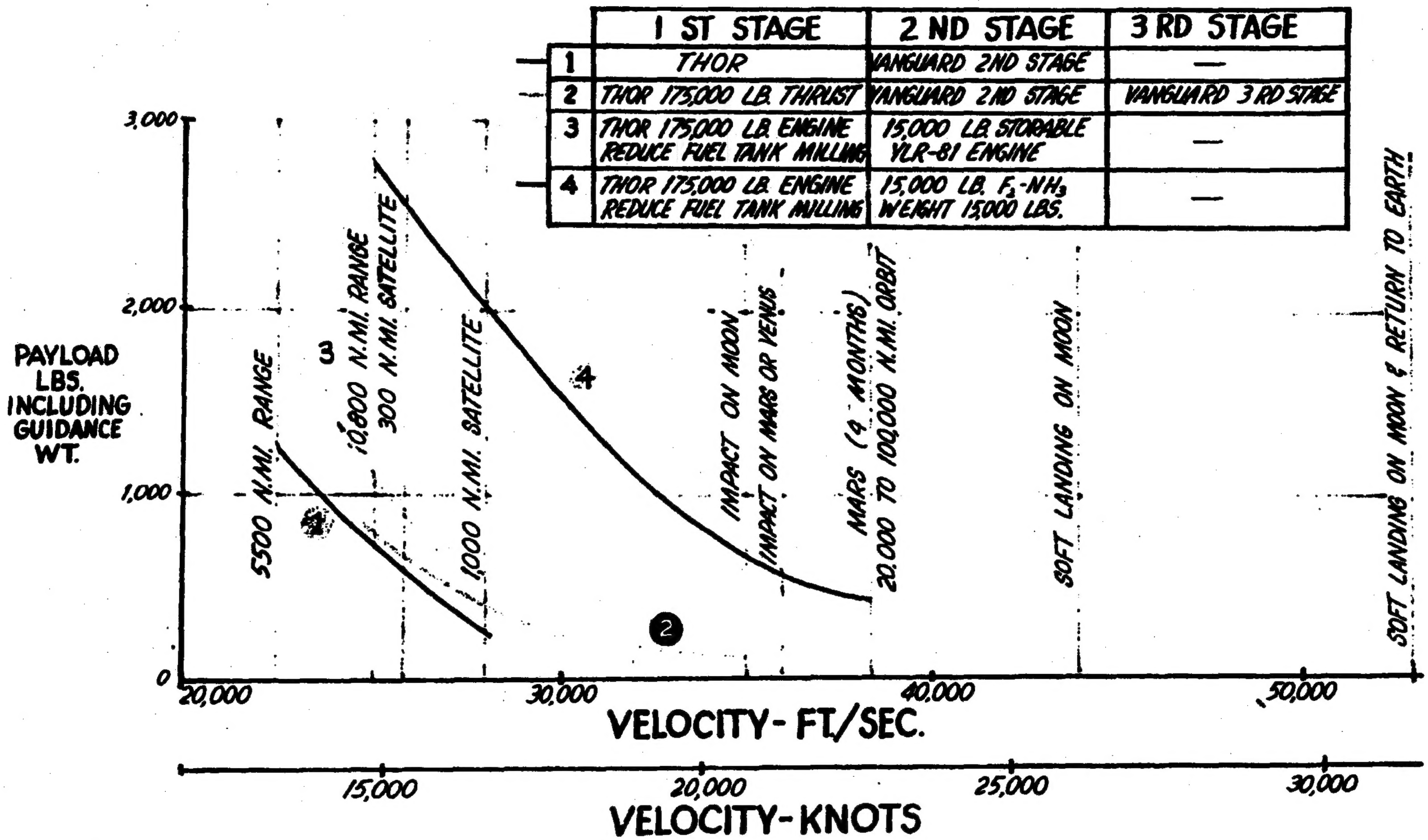
THOR CAPABILITY WITH ADDED STAGES
(LIQUID PROPELLANT 2 ND STAGES)



	1 ST STAGE	2 ND STAGE	3 RD STAGE
1	THOR	VANGUARD 2ND STAGE	—
2	THOR 175,000 LB. THRUST	VANGUARD 2ND STAGE	VANGUARD 3 RD STAGE
3	THOR 175,000 LB. ENGINE REDUCE FUEL TANK MILLING	15,000 LB. STORABLE YLR-81 ENGINE	—
4	THOR 175,000 LB. ENGINE REDUCE FUEL TANK MILLING	15,000 LB. F_2-NH_3 WEIGHT 15,000 LBS.	—

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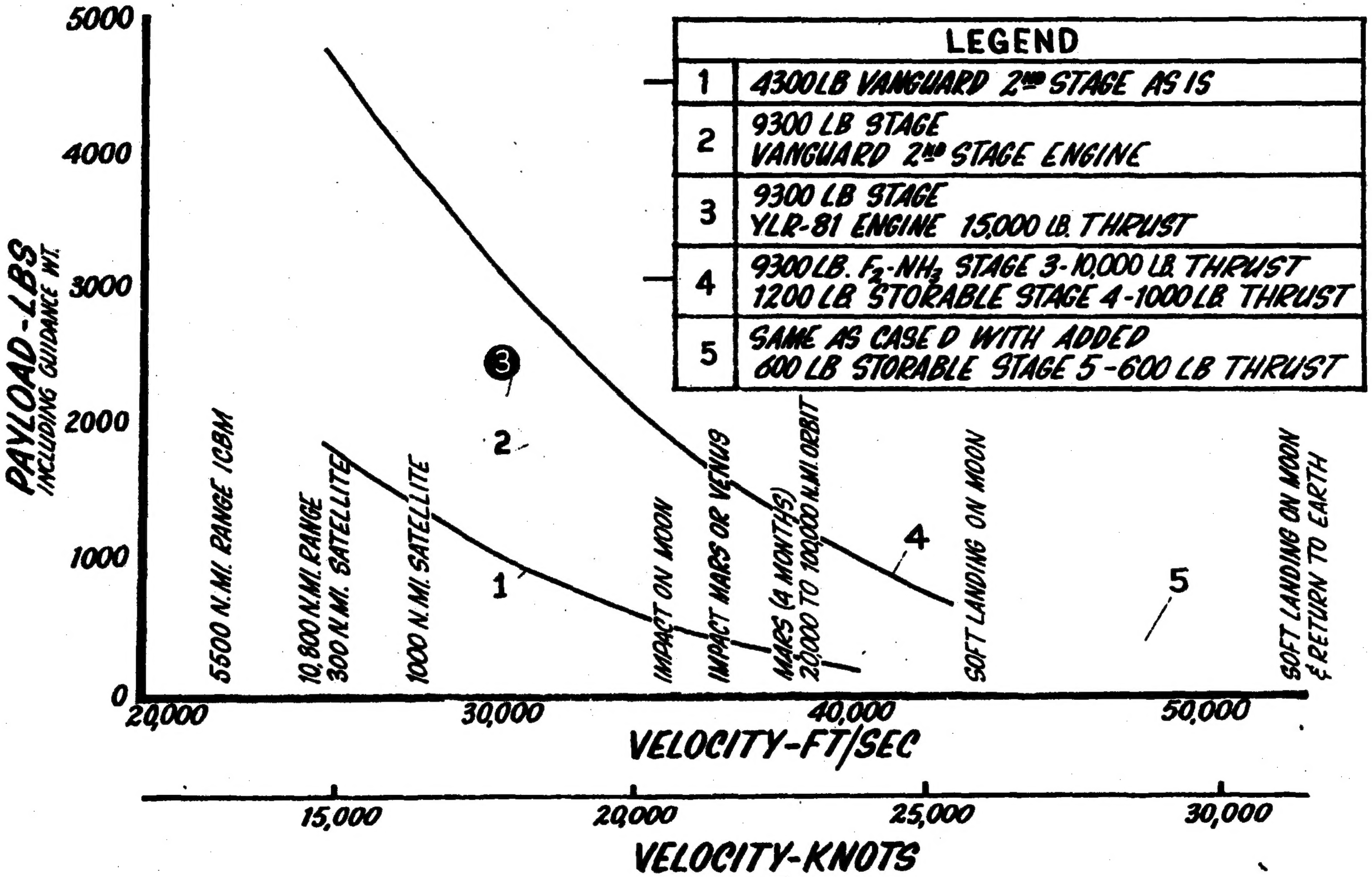
ATLAS CAPABILITY WITH ADDED STAGES



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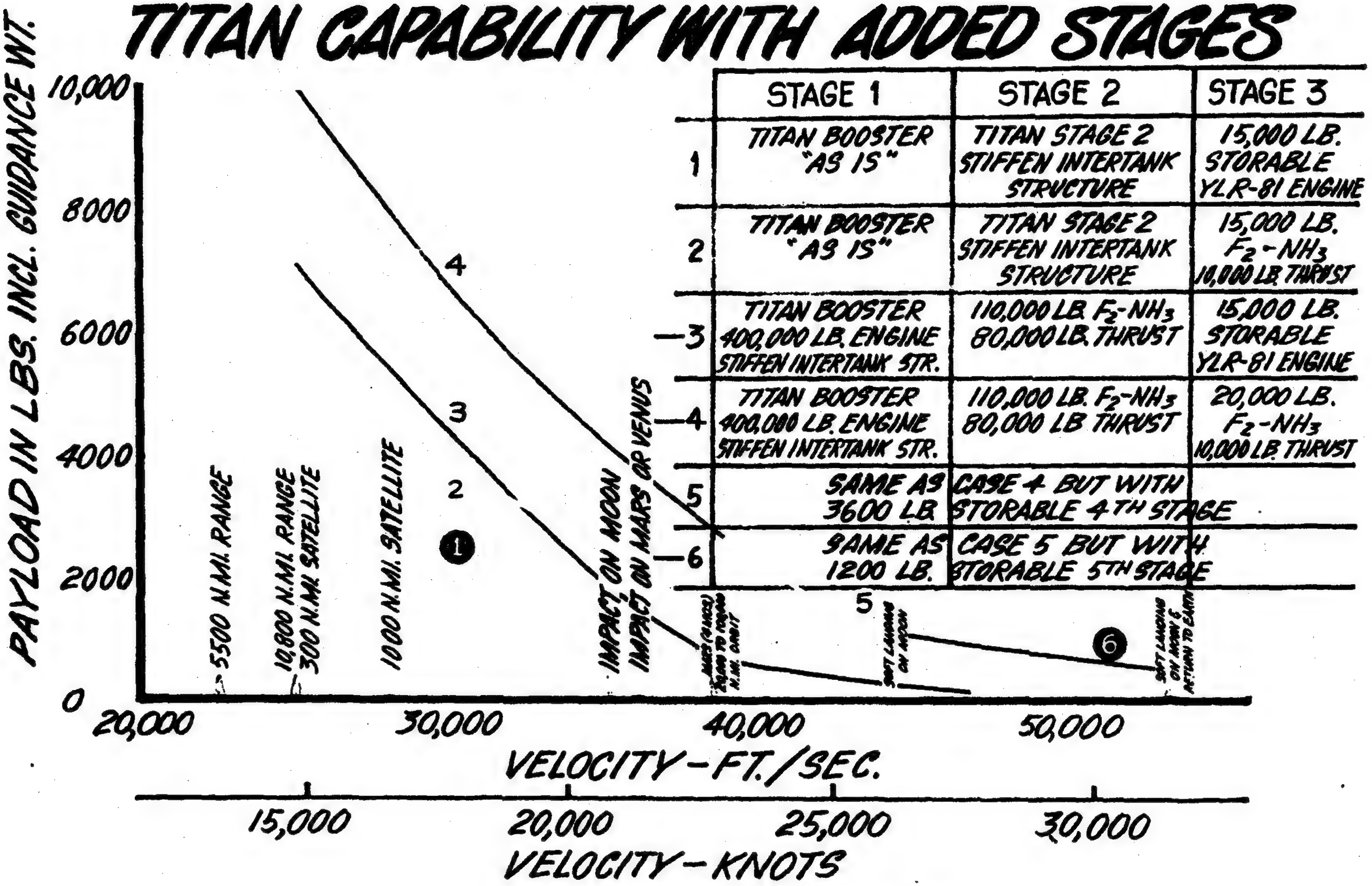
TITAN CAPABILITY WITH ADDED STAGES



	STAGE 1	STAGE 2	STAGE 3
1	TITAN BOOSTER "AS IS"	TITAN STAGE 2 STIFFEN INTERTANK STRUCTURE	15,000 LB. STORABLE YLR-81 ENGINE
2	TITAN BOOSTER "AS IS"	TITAN STAGE 2 STIFFEN INTERTANK STRUCTURE	15,000 LB. F_2-NH_3 10,000 LB. THRUST
3	TITAN BOOSTER 400,000 LB. ENGINE STIFFEN INTERTANK STR.	110,000 LB. F_2-NH_3 80,000 LB. THRUST	15,000 LB. STORABLE YLR-81 ENGINE
4	TITAN BOOSTER 400,000 LB. ENGINE STIFFEN INTERTANK STR.	110,000 LB. F_2-NH_3 80,000 LB THRUST	20,000 LB. F_2-NH_3 10,000 LB. THRUST
5	SAME AS 3600 LB	CASE 4 BUT WITH STORABLE 4TH STAGE	
6	SAME AS 1200 LB.	CASE 5 BUT WITH STORABLE 5TH STAGE	

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300 N. MILE ALTITUDE SATELLITE

	1ST STAGE	2ND STAGE	3RD STAGE	PAYLOAD INCL. GUIDANCE	GUIDANCE CONSIDERATIONS
1.	THOR "AS IS"	1 VANGUARD (3RD STAGE)	—	50-100 LBS (NO GUIDANCE)	AUTOPILOT ONLY IN THOR SPUN-2ND STAGE 160 MI ECCENTRICITY
2.	THOR "AS IS"	4 VANGUARDS (3RD STAGE)	—	200-400 LBS (NO GUIDANCE)	INERTIAL GUID. ON THOR SPUN-2ND STAGE 70 MI ECCENTRICITY
3.	THOR "AS IS"	SERGEANT		0	CASES 3 – 10 GUIDANCE IN FINAL STAGE ORBIT ELLIPICITY WILL BE ±½ MI. WITH PRES. ICBM RADIO SYST. ±3 MI WITH PRES. ICBM ALL INERTIAL SYST. GUIDANCE WEIGHTS • RADIO SYSTEM ~ 175 LBS • ALL INERTIAL SYS ~ 460 LBS • POWER SUPPLY - 50 LBS
✓4.	THOR "AS IS"	VANGUARD (2ND STAGE)	—	600 LBS.	
5.	THOR 175,000 LBS	15,000 LB STORBL. YLR-81 ENGINE	—	1,000 LBS.	
✓6.	THOR THRUST 175,000 LBS THICKER FUEL TANKS	WT 15,000 LBS $F_2 - NH_3$	—	2,800 LBS.	
✓7.	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT. 9,300 LBS STORABLE PROPELLANTS I_{sp} = 270 SEC.	3,200 LBS.	
8.	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT. 9300 LBS F_2 NH_3	4760 LBS.	
✓9.	TITAN BOOSTER AS IS 300,000 LB THRUST	TITAN 2ND STAGE "AS IS" (INTERTANK STRUC. REINFOR.)	WT. 15,000 LBS F_2 NH_3	5,900 LBS.	
✓10.	TITAN BOOSTER AIRFRAME "AS IS" ENG. UPRATED TO 400,000 LBS	WT 110,000 LBS F_2 NH_3	WT. 20,000 LBS F_2 NH_3	10,000 LBS.	

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HIGH ALTITUDE SATELLITES
(15,000 to 150,000 MILES)

	FIRST STAGE	SECOND STAGE	THIRD STAGE (BURNS IN TWO PERIODS)	PAYLOAD INCLUDING GUIDANCE *
✓1.	THOR 175,000 LB. ENGINE THICKER FUEL TANK	TWO PERIOD BURNING 15,000 LB. WT. F_2-NH_3		430 LB. THREE STAGE SHOULD BE APPRECIABLY BETTER
2.	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	9300 LB. STORABLE PROPELLANTS $I_{sp}=270$ SEC.	200 LBS.
3.	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	9300 LB. F_2-NH_3	1260 LBS.
✓4.	TITAN BOOSTER "AS IS"	TITAN 2nd STAGE "AS IS" WITH INTERTANK STRUCTURE STIFFENED	15,000 LB. WT. F_2-NH_3	1200 LBS.
✓5.	TITAN AIRFRAME "AS IS" ENG. UP TO 400,000 LB.	110,000 LB. WT. F_2-NH_3	20,000 LB. WT. F_2-NH_3	2700 LBS.

* PRESENT ARMA ALL INERTIAL GUIDANCE SYSTEM (460 LB.) GIVES ORBITS WITH ABOUT:
{ ±30 MILES ELLIPTICITY AT 15,000 MILES.
{ ±600 MILES ELLIPTICITY AT 150,000 MILES.

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MANNED EXPLORATION OF SATELLITE AND RE-ENTRY ENVIRONMENTS

	1ST STAGE	2ND STAGE	3RD STAGE	TRAJECTORY	PAYLOAD INCLUDING GUIDANCE
1	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	NONE	$V_B \approx 29{,}000$ FT/SEC	2000 LB
2	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT. 9300 LB STORABLE (I_{sp}=270) PROPELLANTS	200 MI. ALTITUDE SATELLITE	3500 LB
3	TITAN BOOSTER "AS IS"	TITAN 2ND STAGE "AS IS" INTERTANK STIFFENING	WT 15000 LB F_2-NH_3	300 MI. ALTITUDE SATELLITE	3800 LB
4	TITAN BOOSTER AIRFRAME "AS IS" 400,000 LB ENGINE	WT 110,000 LB F_2-NH_3	WT 20,000 LB F_2-NH_3	300 MI. ALTITUDE SATELLITE	6500 LB

NOTE:
1. RE-ENTRY ANGLE APPROXIMATELY 2°; ~5 MINUTES FREE FLIGHT
2. RE-ENTRY ANGLE APPROXIMATELY 2°, HRS. TO DAYS OF FREE FLT.
3. TIME IN ORBIT ~ DAYS
4. TIME IN ORBIT ~ WEEKS

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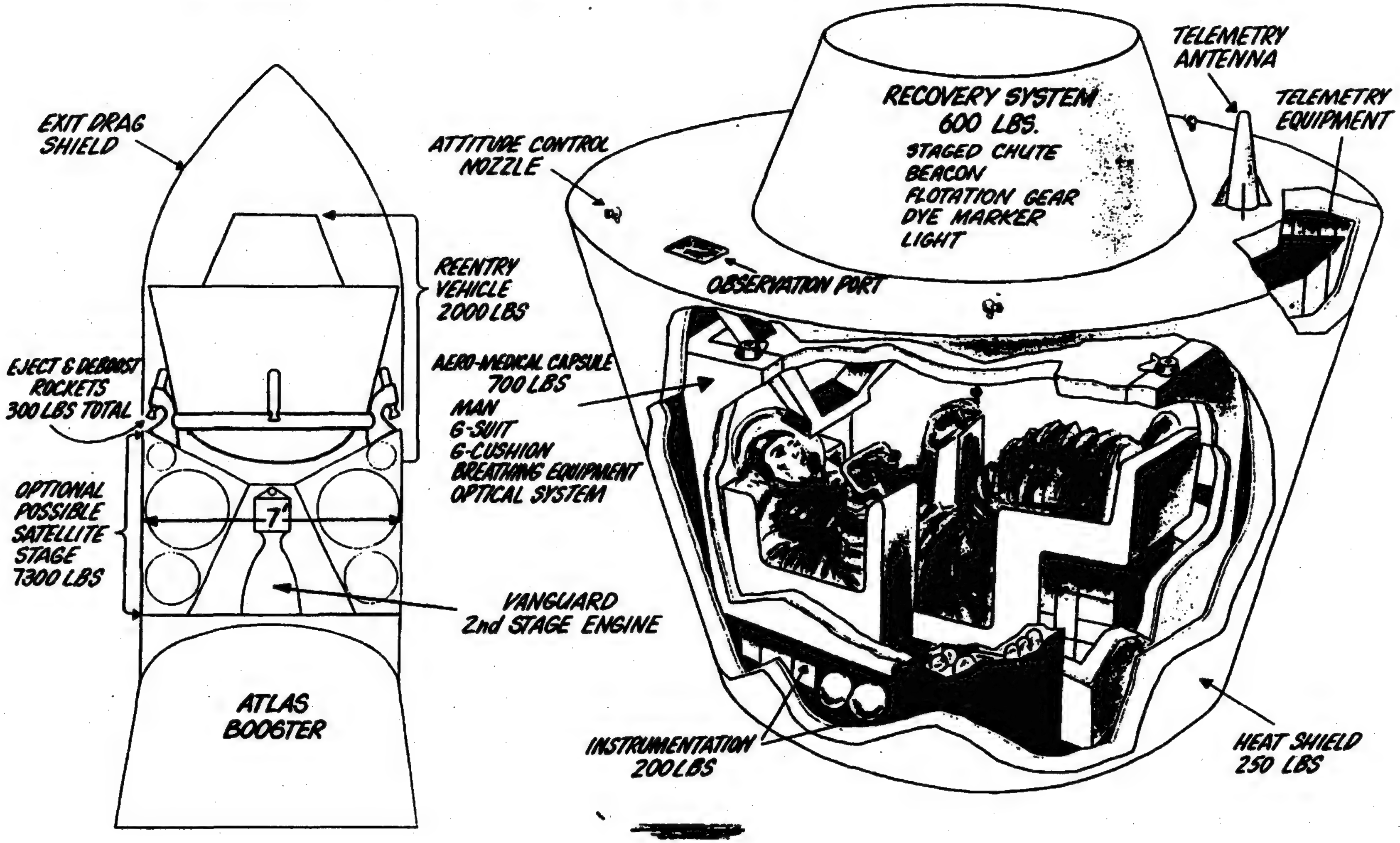
MANNED RE-ENTRY TEST VEHICLE



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MANNED RE-ENTRY STUDY

ASSUMPTIONS

1 **HEAT SHIELD MATERIAL:** *SAME AS ADVANCED ICBM - AVAILABLE CY59*

2 **RECOVERY SYSTEM:** *COOK SYSTEM IMPROVED*

3 **CONTRACTOR:** *PREFERABLY ONE IN PRESENT NOSE CONE PROGRAM—TO USE DEVELOPED BACKGROUND*

4 **FLIGHT PROGRAM:**

10 FLIGHTS WITH APES — *5 PAYLOAD CAPSULES*
10 HEAT SHIELDS
10 RECOVERY SYSTEMS

12 MANNED FLIGHTS — *12 COMPLETE VEHICLES*

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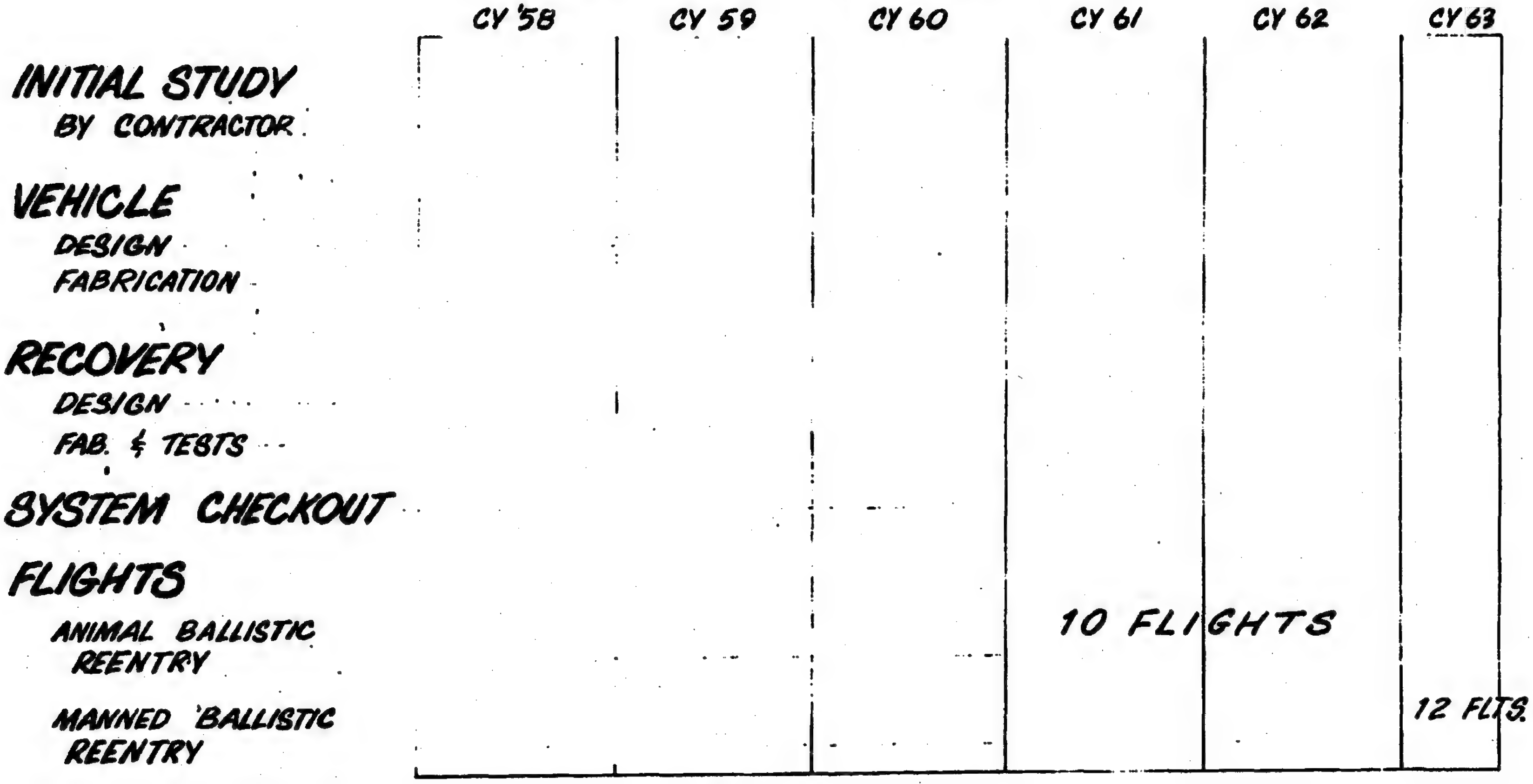
MANNED BALLISTIC RE-ENTRY

DEVELOPMENT SCHEDULE



ESTIMATED COST : $45,000,000.

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IMPACT ON MOON

	1st STAGE	2nd STAGE	3rd STAGE	PAYLOAD INCLUDING GUIDANCE
1	THOR 'AS IS' (GUIDANCE ONLY IN THOR)	4 VANGUARDS	1 VANGUARD	50-100 LBS. (NO GUIDANCE)
2	THOR	XM-34	VANGUARD 3rd STAGE	50 LBS.
✓ 3	THOR 175,000 LBS.	VANGUARD 2nd STAGE	VANGUARD 3rd STAGE	160 LBS.
4	THOR 175,000 LBS.	15,000 LBS-STORABLE YLR-81 - ENGINE	————	0
✓ 5	THOR THRUST 175,000 LBS. THICKER FUEL TANK	WT. 15,000 LBS. F_2-NH_3	————	650 LBS.
6	ATLAS BOOST STAGE 'AS IS'	ATLAS SUSTAINER 'AS IS'	WT. 9,300 LBS. $I_{sp} = 270$	700 LBS.
7	ATLAS BOOST STAGE 'AS IS'	ATLAS SUSTAINER 'AS IS'	WT. 9,300 LBS. F_2-NH_3	2,000 LBS
✓ 8	TITAN BOOSTER 'AS IS'	TITAN 2nd STAGE 'AS IS' INTERTANK REINFORCEMENT	WT. 15,000 LBS. F_2-NH_3	2,150 LBS.
✓ 9	TITAN BOOSTER AIRFRAME 'AS IS' THRUST 400,000 LBS.	WT. 110,000 LBS. F_2-NH_3	WT. 20,000 LBS. F_2-NH_3	4,200 LBS.

CASE 1 THRU 3 BETWEEN 10% AND 50% CHANCE OF HITTING MOON

CASES 5 THRU 9: PRESENT RADIO GUIDANCE SYSTEM (175 LBS.+50 LBS. P.S.) WOULD PRODUCE C.E.P. ON MOON ≅ 70 MI.
PRESENT ALL INERTIAL GUIDANCE (460 LBS.+50 LBS. P.S.) WOULD PRODUCE C.E.P. ON MOON ≅ 70 MI.

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CIRCUMLUNAR FLIGHT & SOFT LANDING ON EARTH (AERODYNAMIC DECELERATION)

	1 ST STAGE	2 ND STAGE	3 RD STAGE	PAYLOAD* INCLUDING GUID. & RETURN TO EARTH
1	THOR "AS IS"	4 VANGUARDS	1 VANGUARD	50 LB. (MARGNAL)
✓2	THOR THRUST 175,000 LBS. THICKER FUEL TANK	WT. 15,000 LBS. F_2-NH_3	(THREE STAGE WOULD BE BETTER)	400 LBS.
3	ATLAS BOOSTER STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT. 9,300 LBS. $I_{sp}=270$ STORABLE PROPELLANTS	0 LBS.
4	ATLAS BOOSTER STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT. 9,300 LBS. F_2-NH_3	1,250 LBS.
✓5	TITAN BOOSTER "AS IS"	TITAN 2 ND STAGE "AS IS" "INTERTANK STIFFENING"	WT. 15,000 LBS. F_2 NH_3	1350 LBS
✓6	TITAN BOOSTER AIRFRAME "AS IS" THRUST 900,000 LBS	WT. 110,000 LBS. F_2-NH_3	WT. 20,000 LBS. F_2-NH_3	2,700 LBS.

*GUIDANCE CONSIDERATIONS

CASE 1: THOR GUIDANCE IN 1ST STAGE. NEGLIGIBLE PROBABILITY OF HITTING EARTH ON RETURN.

CASES 2-6: PRESENT RADIO GUIDANCE (170 LB. + 50 LB. P.S.) IN THIRD STAGE (2ND FOR CASE 2) WOULD PRODUCE ± 700 MILE ERROR IN DISTANCE FROM BACK OF MOON.
ERROR ON RETURN TO EARTH WOULD BE ABOUT ± 800 MILES ON EARTH CROSS SECTION.
ERROR IN IMPACT POINT WOULD BE CONSIDERABLY GREATER.

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SOFT LANDING ON MOON

	1ST STAGE	2ND STAGE	3RD STAGE (INCLUD. BOOST GUID.)	LANDING DECELER. STAGE	PAYLOAD INCLUD GUIDANCE DECELERATION *
✓1	THOR THRUST 175,000 LB THICKER FUEL TANK	WT-15 000 LBS F_2 - NH_3 (INCLUD BOOST GUID)	NONE - 3 STAGE WOULD BE BETTER	650 LBS STORABLE PROPELL.	180 LBS
2	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT - 9300 LBS STORABLE PROPELL. I_{sp} = 270	700 LBS STORABLE PROPELL.	200 LBS
3	ATLAS BOOST STAGE "AS IS"	ATLAS SUSTAINER "AS IS"	WT - 9300 LBS F_2 - NH_3	2000 LBS STORABLE PROPELL	600 LBS
4	TITAN BOOST STAGE "AS IS"	TITAN 2ND STAGE "AS IS" INTERTANK REINFORCE.	WT-15000 LBS F_2 - NH_3	2150 STORABLE PROPELL.	750 LBS
✓5	TITAN AIRFRAME "AS IS" ENGINE UP TO 400,000 LB	WT-110,000 LBS F_2 - NH_3	WT-20,000 LBS F_2 - NH_3	9200 LBS STORABLE PROPELL.	1400 LBS

* CEP ON MOON ± 70 MI WITH 170 LB RADIO SYSTEM + 50 LB P.S. IN LAST BOOST STAGE. DECELERATION GUIDANCE SYSTEM - WEIGHT ABOUT 40 LBS FOR IMPACT AT LESS THAN 20 FPS CARRIED IN FINAL STAGE

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SOFT LANDING ON MOON AND RETURN TO EARTH

AERODYNAMIC DECELERATION

	BASIC VEHICLE	1ST STAGE	2ND STAGE	3RD STAGE	MOON LANDING DECELERATION STAGE	ESCAPE FROM MOON STAGE	PAYLOAD * INCLUDING TERMINAL GUIDANCE
1.	ATLAS	BOOST STAGE "AS IS"	SUSTAINER "AS IS"	WT. 9300 LB. STORABLE FUELS-I_{sp}:270	700 LBS STORABLE. PROPELLANTS	200 LBS STORABLE PROPELLANTS	0 LBS
2.	ATLAS	BOOST STAGE "AS IS"	SUSTAINER "AS IS"	WT. 9300 LB. F_2-NH_3	2000 LBS F_2-NH_3	820 LBS. F_2-NH_3	250 LB.
3.	TITAN	BOOSTER "AS IS"	2ND STAGE "AS IS" BUT INTERTANK STIFFENED	WT. 15,000 LB. F_2 NH_3	1200 LBS STORABLE PROPELLANTS	460 LBS. STORABLE PROPELLANTS	120 LB.
✓4.	TITAN	BOOSTER AIRFRAME "AS IS" 400,000 LB. ENGINE	WEIGHT 110,000 LBS. F_2-NH_3	WT. 20,000 LB. F_2-NH_3	4200 LBS. F_2 NH_3	1700 LB. F_2-NH_3	520 LB.
✓5.	LARGE MILITARY SATELLITE VEHICLE	WEIGHT 1,500,000 LBS. THRUST 2,000,000 LB. LOX-RP	WEIGHT 500,000 LBS. THRUST 400,000 LBS. F_2-NH_3	WEIGHT 150,000 LBS. THRUST 130,000 LBS. F_2-NH_3	WEIGHT 39,000 LBS. THRUST 20,000 LBS.	WEIGHT 16,000 LBS. THRUST 8,000 LBS.	3,000 LB.

* GUIDANCE CONSIDERATIONS:

1. PRESENT RADIO GUIDANCE SYSTEM IN 3RD STAGE WOULD GIVE 70 MI C.E.P. ON MOON.
2. MOON LANDING GUIDANCE SYSTEM - 40 LBS. IN DECELERATION STAGE.
3. OPTICAL HOMING SYSTEM IN MOON ESCAPE STAGE. NO WEIGHT OR ACCURACY ESTIMATES AVAILABLE.

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INTERPLANETARY MISSIONS

	MISSION		PAYLOADS (INCLUDING TERMINAL GUIDANCE				
		1ST STAGE	THOR 175,000 LB. ENGINE THICKER FUEL TANK	ATLAS BOOST STAGE	ATLAS BOOST STAGE	TITAN BOOSTER 'AS 18'	TITAN 400,000 LB. ENGINE
		2ND	15,000 LB. F_2-NH_3	ATLAS SUSTAINER	ATLAS SUSTAINER	TITAN 2ND STAGE [illegible]	10,000 LB. WT. F_2-NH_3
		3RD	NONE	2300 LBS. STORABLE [illegible]-270	2,300 LB. F_2-NH_3	15,000 LB. WT. F_2-NH_3	20,000 LB. WT. F_2-NH_3
1	PROBE NEAR MARS OR VENUS		✓ 400 LBS.	450 LBS.	1100 LBS.	1300 LBS.	2400 LBS.
2	BEACON ON MARS ATMOSPHERIC DECELERATION		✓ 240 LBS.	270 LBS.	660 LBS.	800 LBS.	✓ 1450 LBS.
3	BEACON ON VENUS ATMOSPHERIC DECELERATION		✓ 300 LBS.	340 LBS.	820 LBS.	950 LBS.	✓ 1800 LBS.
4	MARS LANDING AND RETURN ATMOSPHERIC DECELERATION						110 LB. MARS TAKEOFF STAGE WT. 1800 LBS. STORABLE FUELS
5	SOLAR PROBE, INSIDE ORBIT OF MERCURY						✓ 1000 LB. 4TH STAGE WT. 4,200 LBS. F_2-NH_3

GUIDANCE CONSIDERATIONS: FOR MARS AND VENUS AN ADVANCED GUIDANCE SYSEM (.2 FPS. CUTOFF VELOCITY ERROR) WOULD GIVE PROBABLE MISS OF 10,000 MILES. HENCE A SMALL HOMING CORRECTION WOULD BE SUFFICIENT TO HIT.

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INTERPLANETARY GUIDANCE

INITIAL OR LAUNCH PHASE

PRESENT ICBM SYSTEMS ARE ADEQUATE

MIDCOURSE GUIDANCE

- EARTH RADAR
- LONG BASELINE RADIO
  - EARTH & MOON TRANSPONDERS
  - TRANSPONDERS ON FOUR SATELLITES
- PLANET TRACKER
- STAR TRACKER
- SUN TRACKER

} OPTICAL OR INFRARED

TERMINAL SYSTEMS

- SENSING FOR PROPER APPROACH (OPTICAL OR RADAR)
- CALCULATION & MANEUVER FOR ORBITING OR CLOSE APPROACH
- ALTIMETERS & RETARDING THRUST FOR SOFT IMPACT

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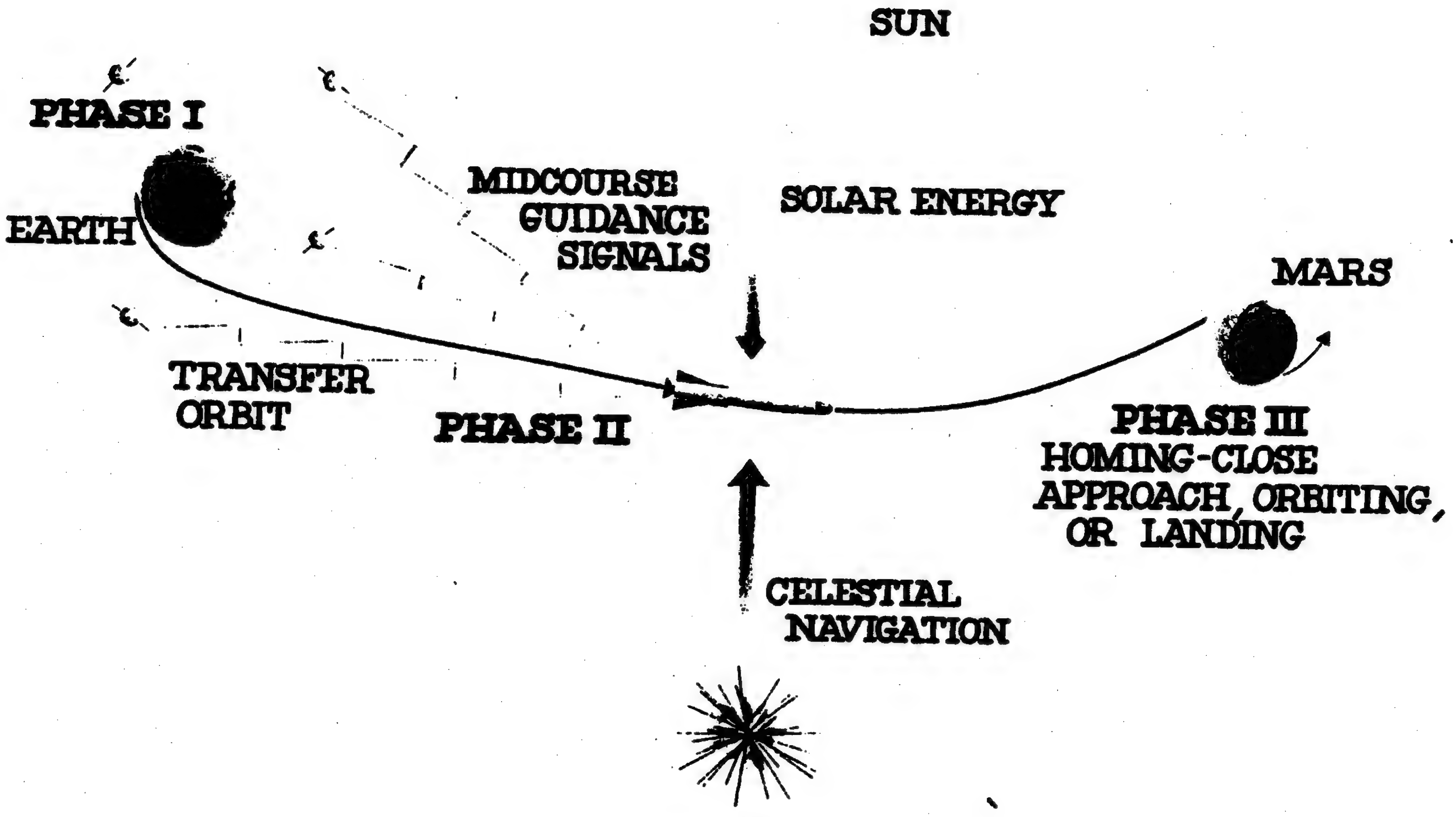

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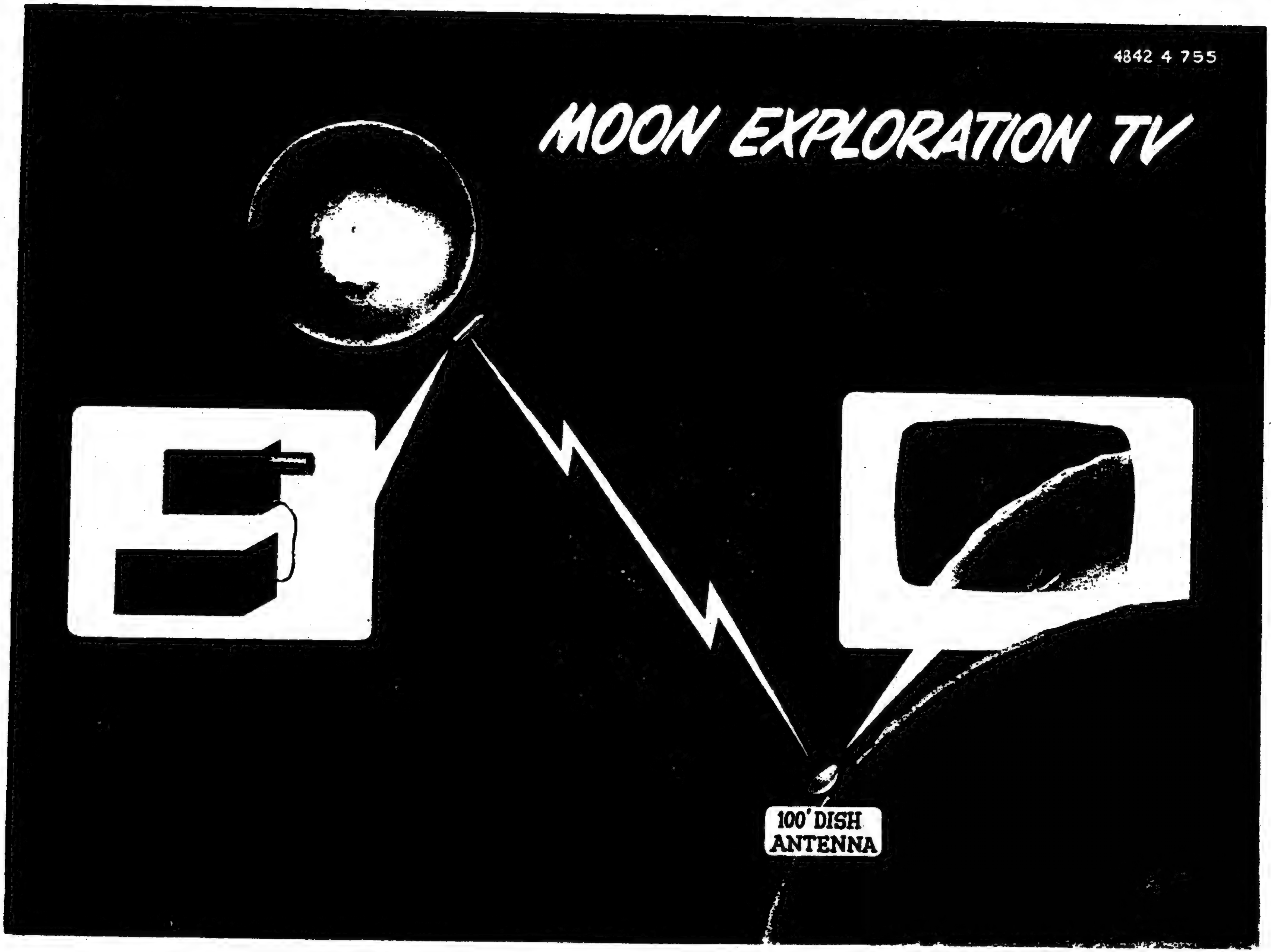
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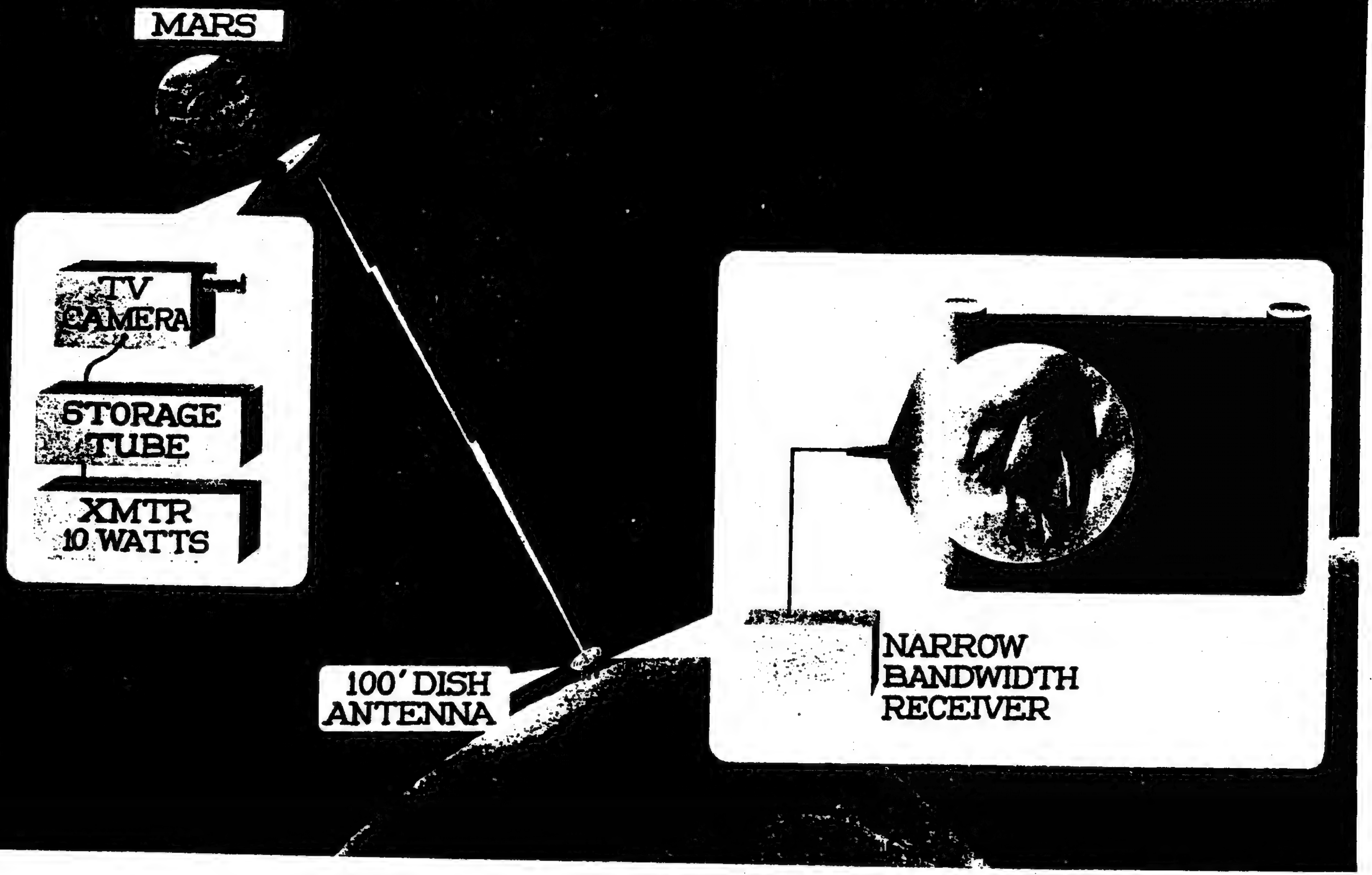
MARS EXPLORATION FACSIMILE



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DATA TRANSMISSION PROBLEMS

I TYPE OF DATA

A. *T. V.*

B. *FACSIMILE*

C. *ANALOG OR DIGITAL MEASUREMENT*

II TRANSMISSION METHOD

A. *REAL TIME*

B. *FAST RETURN*

C. *SLOW RETURN*

D. *DELAYED RETURN*

E. *CAPSULE RECOVERY*

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PROBLEM AREAS

1. ASTROPHYSICAL & PLANETARY CONSTANTS
    - A. ASTRONOMICAL UNIT
    - B. INTERPLANETARY DUST & METEORITE DENSITY
    - C. PLANETARY ATMOSPHERES
2. COMPREHENSIVE STUDY OF TRAJECTORIES & MISS COEFFICIENTS
3. SOFT LANDING PROCEDURES & CORRESPONDING GUIDANCE REQUIREMENTS
4. LIGHT WEIGHT, LOW POWER COMPUTERS
5. PROPULSIVE ENERGY REQUIREMENTS FOR MID COURSE OR TERMINAL GUIDANCE
6. ORBITAL STABILITY OF TRANSPONDER SATELLITES USED IN LONG BASE GUIDANCE SYSTEMS
7. MILLIMETER WAVE COMPONENTS FOR LONG DISTANCE TRANSMISSION
8. HIGH EFFICIENCY ELECTRICAL ENERGY SOURCES
9. TERRESTRIAL COMPONENT TEST PROCEDURES

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PRIMARY COMBINATIONS RECOMMENDED WITH PRESENT BOOSTERS

1. THOR + VANGUARD 2ND STAGE (+ VANGUARD 3RD STAGE)
2. THOR + 15,000 LB F_2 STAGE
3. ATLAS + 9300 LB VANGUARD ENGINE STAGE (MANNED REENTRY ONLY)
4. ATLAS + PRESENT 117-L STAGE
5. TITAN 1ST STAGE + TITAN 2ND STAGE + 15,000 LB. F_2 STAGE.
6. TITAN 1ST STAGE + 110,000 LB. F_2 + 20,000 LB. F_2 STAGE.

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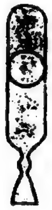
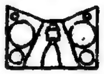
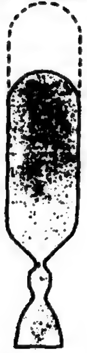
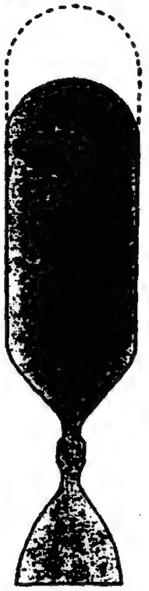
FAMILY OF ADDITIONAL STAGES FOR PRESENT BOOSTRS







NEW TITAN 2ND STAGE
NEW ENGINE & TANKS



	EXISTING VANGUARD STAGE 2 ENGINE & TANKS	VANGUARD 2nd STAGE ENG. NEW TANKS	NEW ENGINE & TANKS	NEW TITAN 2ND STAGE NEW ENGINE & TANKS
STAGE WEIGHT				
NOMINAL-LBS	3800	9300	15,000	110,000
ALTERNATE-LBS	–	—	20,000	150,000
PROPULSION				
ENGINE	VANGUARD STG 2	VANGUARD 2nd STAGE	NEW ENGINE	NEW ENGINE
PROPELLANT	WFNA-UDMH	WFNA-UDMH	F_2NH_3 OR $F_2\text{-}N_2H_4$	F_2NH_3 OR $F_2\text{-}N_2H_4$
PRESSURE FED CHAR.				
THRUST-LBS	7700	7700	10,000	80,000
I_{SP} -SEC	270	270	370	370
CHAMBER PRESS-PSI	200	200	120	150
TURBOPUMP FED				
THRUST LBS	-	—	-	135,000
I_{SP} SEC	-	—	-	370
CHAMBER PRESS-PSI	-	—	—	250
EXPANSION RATIO	20:1	20:1	30:1	25:1
STAGE USED WITH BOOSTERS	THOR;	THOR, ATLAS TITAN	THOR, TITAN SUPER TITAN	TITAN

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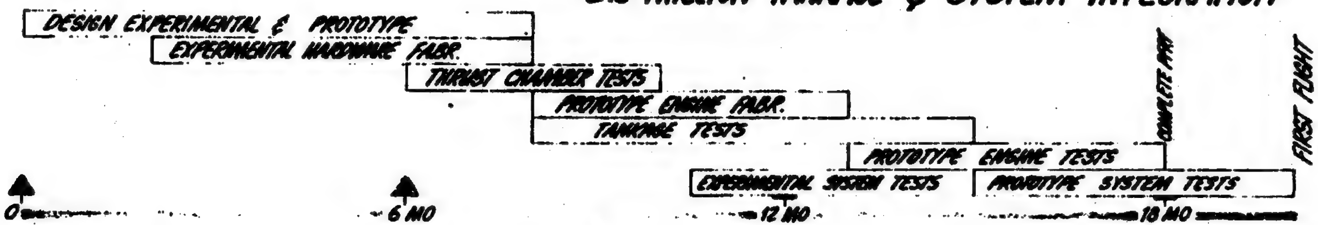
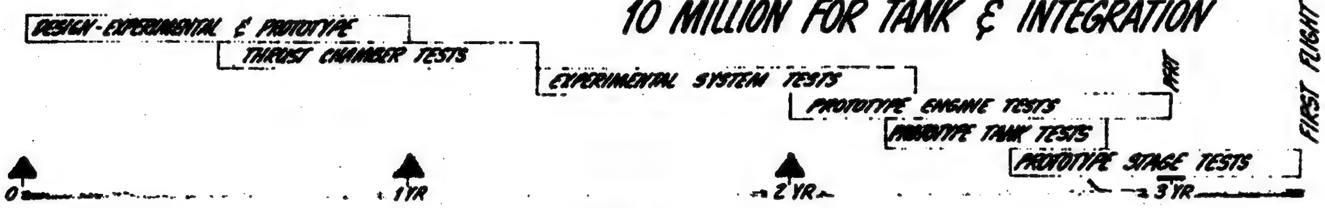
DEVELOPMENT OF ADDITIONAL STAGES FOR PRESENT BOOSTERS

1. VANGUARD STAGE II - AVAILABLE ON 60 DAY NOTICE-NO DEVELOPMENT REQUIRED
2. STORABLE 9300 LB STAGE VANGUARD ENG AVAILABLE-STAGE DEVELOPMENT COST ~ $ 3 MILLION
   STAGE DEVELOPMENT TIME ~ 8 MONTHS.
3. FLUORINE 15000 LB STAGE-ESTIMATED COST $ 8.0 MILLION
   6.0 MILLION ENGINE
   2.0 MILLION TANKAGE & SYSTEM INTEGRATION



4. FLUORINE 110,000 LB STAGE-ESTIMATED COST $ 50 MILLION
   40 MILLION FOR ENGINE
   10 MILLION FOR TANK & INTEGRATION



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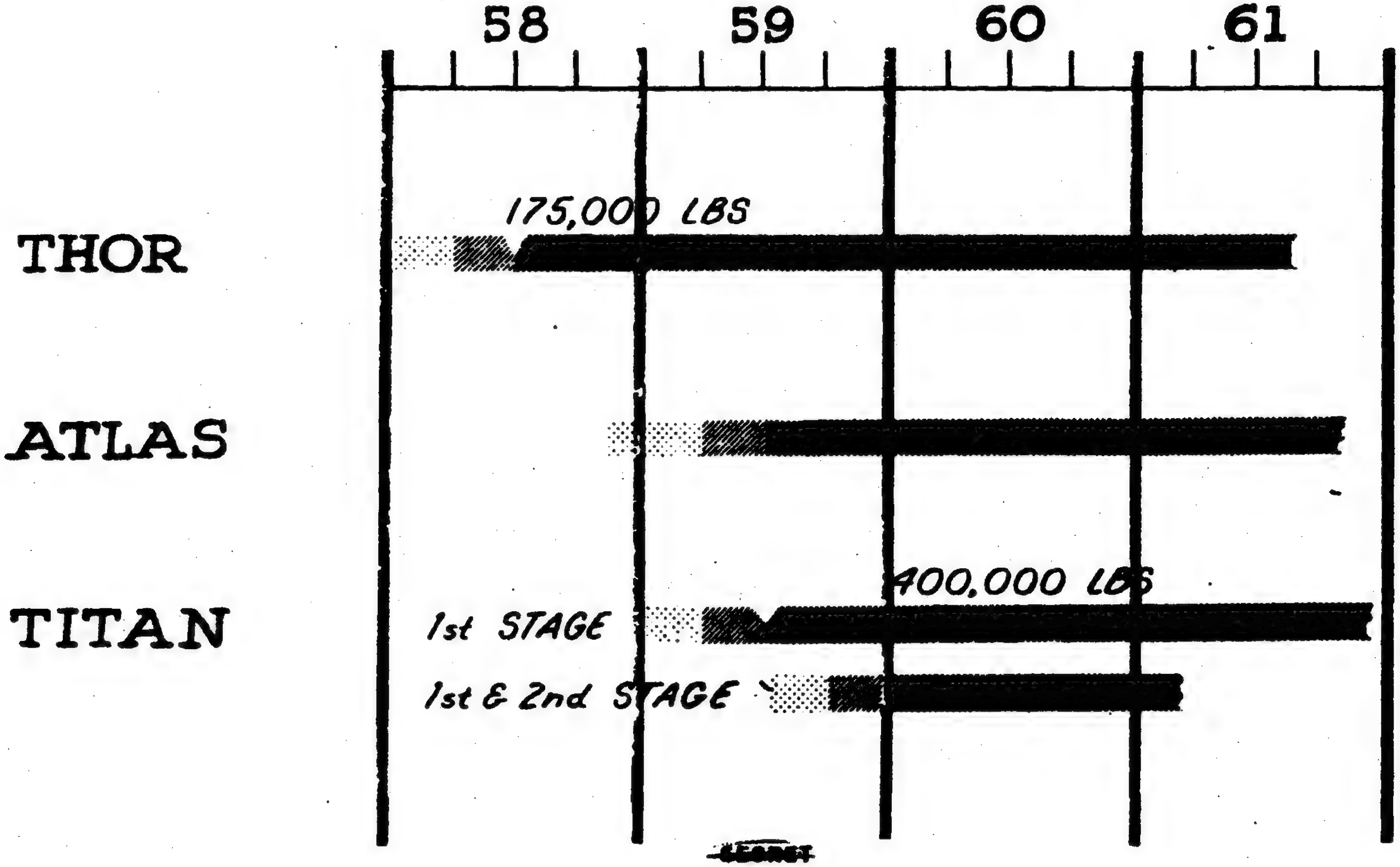
BOOSTER AVAILABILITY



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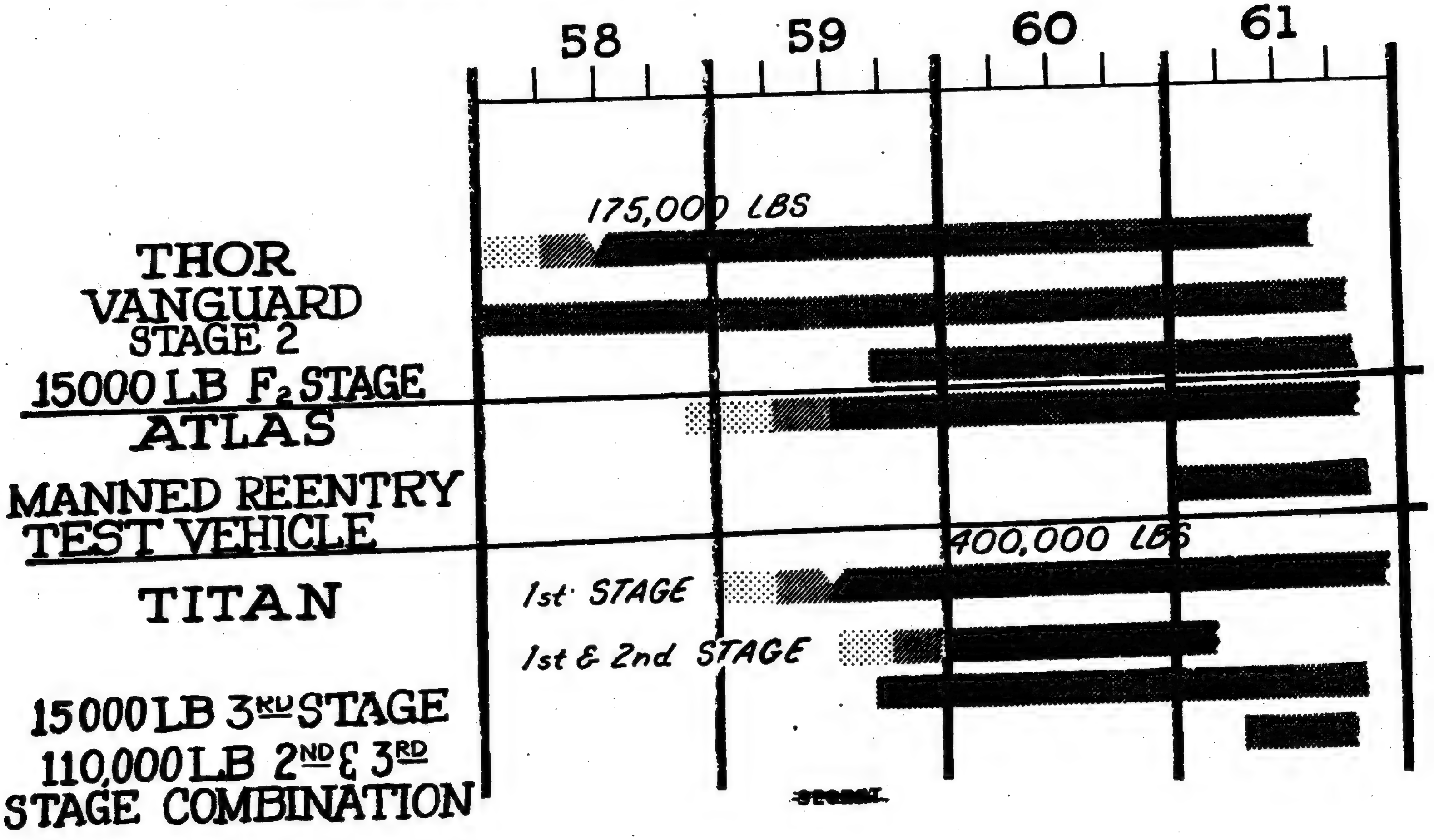
BOOSTER AVAILABILITY

ADDED STAGE AVAILABILITY



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VEHICLE COMBINATIONS APPLICABLE TO RECOMMENDED MISSIONS

1. **RECONNAISSANCE - (117 L)**
   - THOR + VANGUARD (EARLY EXPERIMENTAL FLIGHTS)
   - ATLAS + YLR-81

2. **COMMUNICATIONS**
   - THOR + 15,000 LB. F_2 STAGE
   - TITAN 1ST STAGE + TITAN 2nd STAGE + 15,000 LB. F_2 STAGE
   - TITAN 1ST STAGE + 110,000 LB. F_2 + 20,000 LB. F_2

3. **MANNED SPACE FLIGHT**
   - THOR + VANGUARD (ANIMAL EXPERIMENTS; DATA GATHERING)
   - TITAN 1ST STAGE + TITAN 2nd STAGE + 15,000 LB. F_2
   - TITAN 1ST STAGE + 110,000 LB. F_2 + 20,000 LB. F_2

4. **TECHNICAL DEVELOPMENT & EXPERIMENTAL SUPPORT**
   - ALL VEHICLES APPLICABLE AS DICTATED BY PAYLOAD REQUIREMENTS
   - FOR EXAMPLE: ATLAS FOR INITIAL MANNED REENTRY TESTS

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PAYLOADS FOR SPACE MISSIONS

(INCLUDING FINAL STAGE GUIDANCE WEIGHTS)

	300 N. MI. SATELLITE *	IMPACT ON MOON *	AROUND MOON AND RETURN *	SOFT LANDING ON MOON **	AERO LANDING ON MARS ***
THOR + VANGUARD STAGE 2	600 LBS	—	—	—	—
THOR F2-STAGE 2	2,800 LBS	650	400	180	240
TITAN + F2-STAGE 3	5,900 LBS	2,150	1,350	750	800
TITAN BOOSTER F2-STAGES 2 & 3	10,000 LBS	4,200	2,700	1400	1,450

* USING PRESENT ICBM GUIDANCE, DEDUCT 225 LBS. FROM THESE PAYLOADS.

** PRESENT ICBM GUIDANCE PROVIDED IN [redacted] 3RD STAGE. LANDING GUIDANCE EST. AT 40 LBS.

*** WEIGHT OF TERMINAL GUIDANCE SYSTEM MUST BE DEDUCTED.

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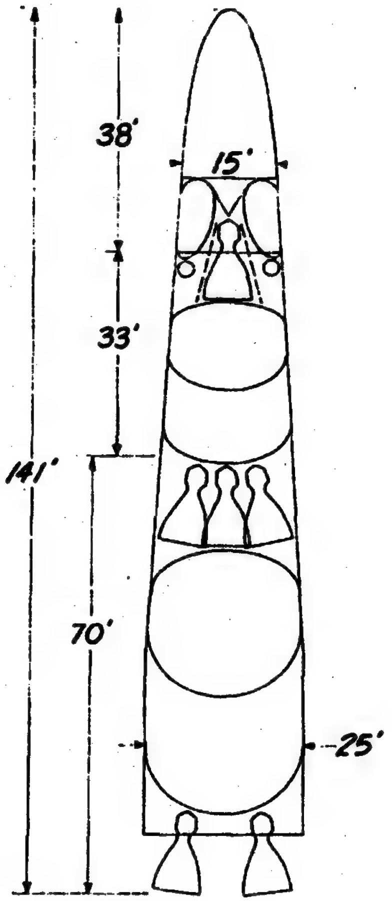
LARGE MILITARY SATELLITE VEHICLE (MANNED)



SATELLITE STAGE

PAYLOAD IN 20,000 MI. ORBIT	= 20,000 LBS.
RECOVERABLE PAYLOAD	= 12,000 LBS.
GROSS WEIGHT	= 40,000 LBS.

3RD STAGE

WEIGHT (INCLUDING LATER STAGE)	= 150,000 LBS.
THRUST –	= 135,000 LBS.
ENGINE – F_2-NH_3 OR F_2-N_2H_4 WITH TURBOPUMP (PRESSURIZED 80,000 LB. ENGINE PLUS TURBOPUMP)	
THRUST CHAMBER AVAILABLE FROM PRESSURIZED ENGINE	
ESTIMATED ENGINE DEVELOPMENT TIME	– 4 YEARS
ESTIMATED ENGINE DEVELOPMENT COST	– $50 MILLION

2ND STAGE

WEIGHT (INCLUDING LATER STAGES)	= 500,000 LBS.
THRUST –	= 405,000 LBS.
PROP. SYSTEM – THREE 135,000 LB. 3RD STAGE ENGINES (F_2-NH_3 OR F_2-N_2H_4)	
ESTIMATED SYSTEM DEVELOPMENT TIME 5 YRS. TOTAL	– 1 YR. AFTER 3RD STAGE ENGINE AVAILABLE
ESTIMATED SYSTEM DEVELOPMENT COST	$20 MILLION (3RD STAGE)

1ST STAGE

WEIGHT (INCLUDING LATER STAGES)	= 1,500,000 LBS.
THRUST –	= 2,000,000 LBS.
ENGINE – TWO 1,000,000 LB. LOX-RP (ALTERNATE – FOUR 500,000 LB. LOX-RP)	
ESTIMATED ENGINE DEVELOPMENT TIME	– 4 YRS.
ESTIMATED ENGINE DEVELOPMENT COST	$135 MILLION

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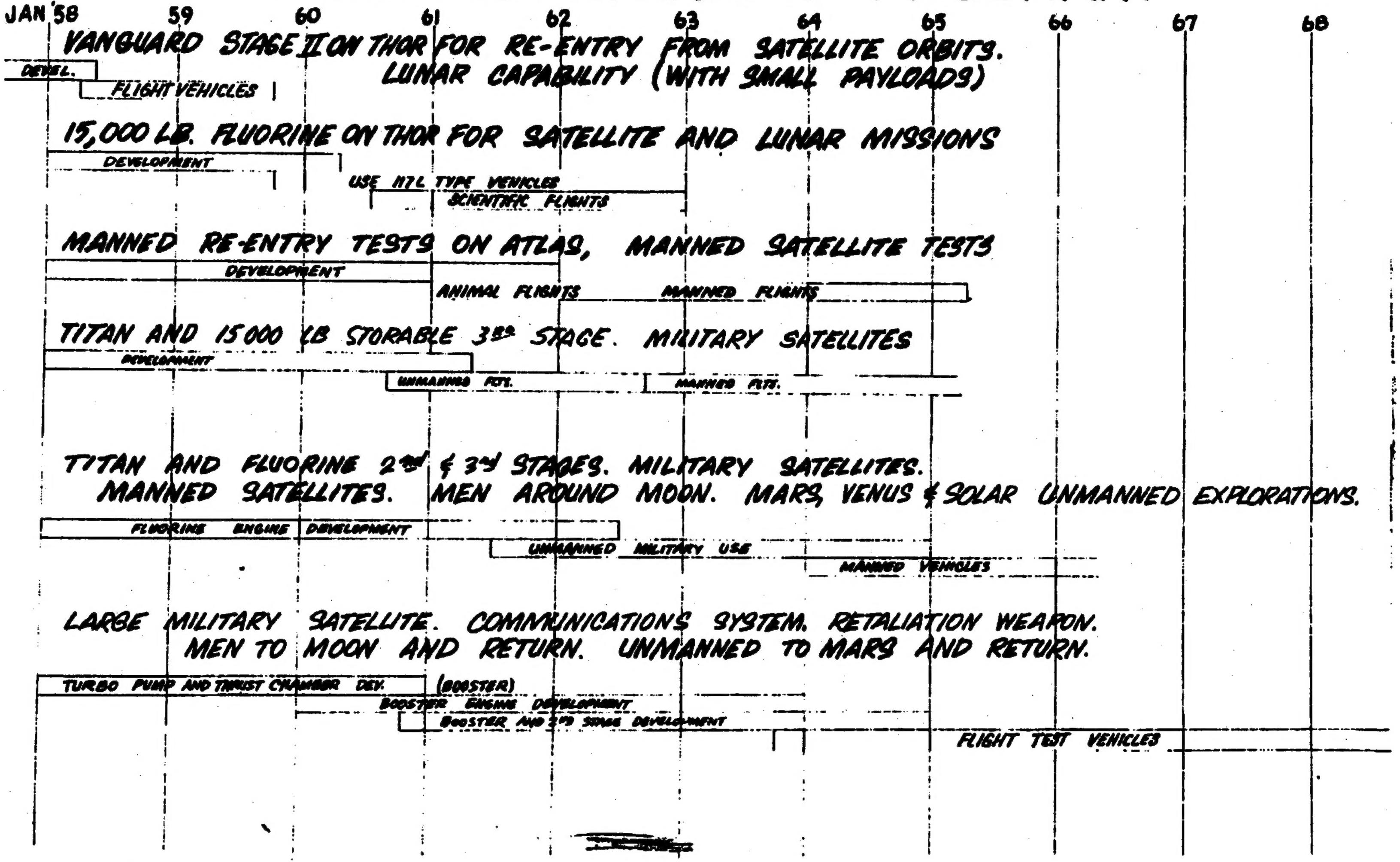
AIR FORCE MILITARY SATELLITE & SPACE TECHNOLOGY PROGRAM



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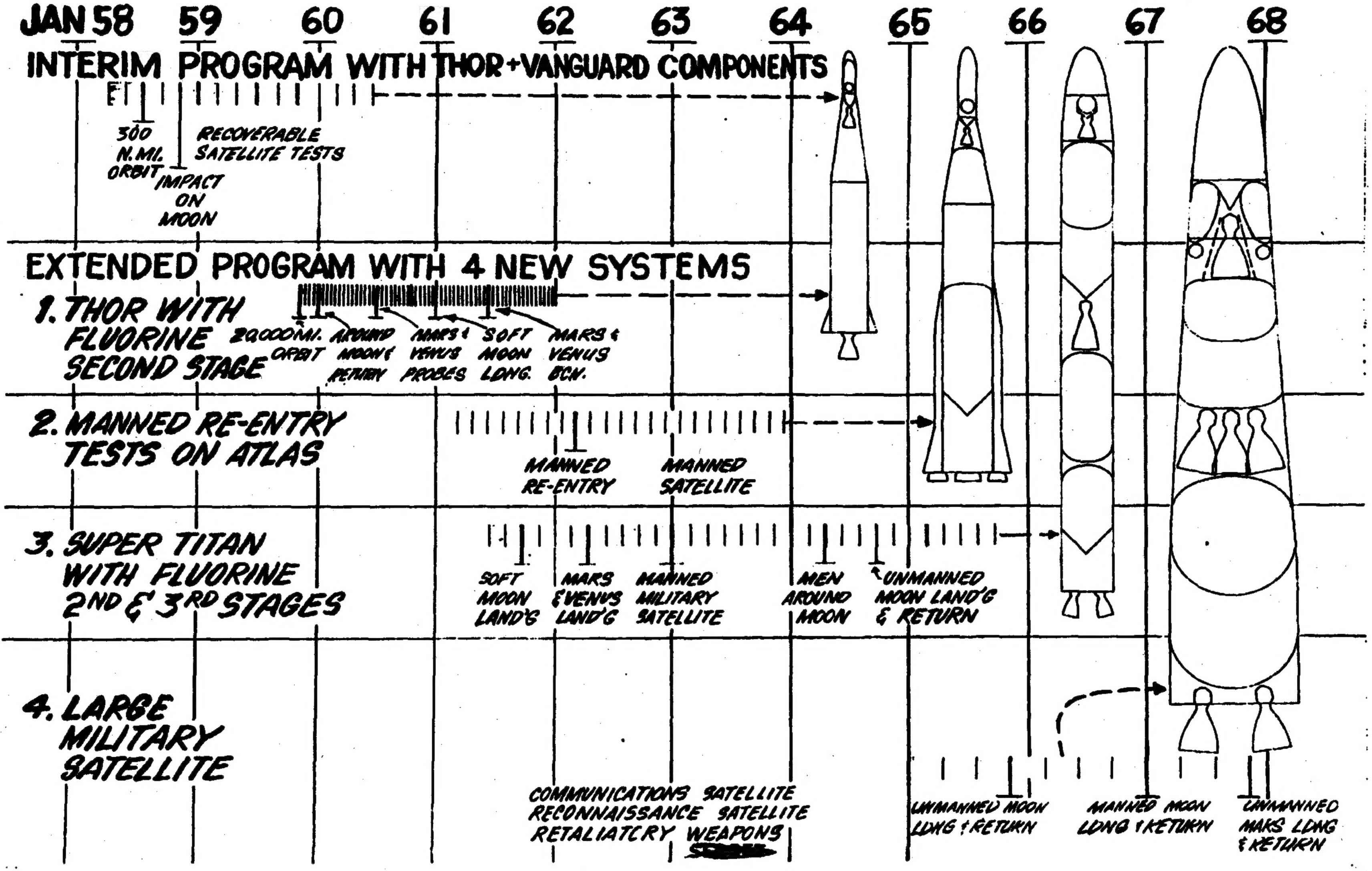
AF MIL. SATELLITE & SPACE TECHNOLOGY CALENDAR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INTERIM PROGRAM WITH THOR+VANGUARD COMPONENTS
300 N.MI. ORBIT
IMPACT ON MOON
RECOVERABLE SATELLITE TESTS
EXTENDED PROGRAM WITH 4 NEW SYSTEMS
1. THOR WITH FLUORINE SECOND STAGE
20,000 MI. ORBIT
AROUND MOON & RETURN
MARS & VENUS PROBES
SOFT MOON LDNG.
MARS & VENUS BCN.
2. MANNED RE-ENTRY TESTS ON ATLAS
MANNED RE-ENTRY
MANNED SATELLITE
3. SUPER TITAN WITH FLUORINE 2ND & 3RD STAGES
SOFT MOON LAND'G
MARS & VENUS LAND'G
MANNED MILITARY SATELLITE
MEN AROUND MOON
UNMANNED MOON LAND'G & RETURN
4. LARGE MILITARY SATELLITE
COMMUNICATIONS SATELLITE
RECONNAISSANCE SATELLITE
RETALIATORY WEAPONS
UNMANNED MOON LDNG & RETURN
MANNED MOON LDNG & RETURN
UNMANNED MARS LDNG & RETURN

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GENERAL CONCLUSIONS

1- PRESENT ATLAS, TITAN, AND THOR PROVIDE BOOSTER CAPACITY FOR SPACE MISSIONS OF PRIMARY INTEREST FOR NEXT 10 YEARS. PRINCIPAL INVESTMENT IN FIRST GENERATION SPACE VEHICLES ALREADY MADE.

2- DEVELOPMENT OF A FEW ADDED STAGES OF SMALL SIZE AS "BUILDING BLOCKS" CAN PROVIDE, IN PROPER COMBINATION WITH THE BOOSTERS, VEHICLES FOR ALL SPACE MISSIONS FOR THE NEXT 10 YEARS.

3- THE GUIDANCE SYSTEMS FOR PRESENT AND SECOND GENERATION ICBM AND IRBM ARE BASICALLY ADEQUATE TO PERFORM THE SPACE MISSIONS.

4- DEVELOPMENT OF "PAYLOADS" FOR SOME OF THE VARIOUS MISSIONS (INCLUDING "PAYLOADS" FOR ANIMAL AND MANNED EXPERIMENTS) CAN BE DEFINED AND INITIATED NOW.

5- RESEARCH AND TECHNICAL DEVELOPMENT REQUIRED ON CRITICAL PROBLEMS AND ON BASIC SPACE PHENOMENA CAN BE DEFINED AND INITIATED NOW FOR THE SECOND GENERATION OF SPACE VEHICLES AND SPACE MISSIONS.

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FY'58 PROGRAM for SATELLITE and SPACE TECHNOLOGY

Basic BOOSTER:		Est. EXPENDITURES
THOR	● ADAPT VANGUARD 2ND STAGE to THOR	$ 3.0 - in Millions
THOR-TITAN	● START DEVELOPMENT of FLUORINE 2ND STAGE —10,000 lb. THRUST, - PRESSURE FED ENGINE	4.0
ATLAS	● INITIATE DEVELOPMENT of MANNED RE-ENTRY TEST VEHICLE	2.5
TITAN	● INITIATE DEVELOPMENT of 80,000 lb. FLUORINE ENGINE	3.0
LARGE Military Satellite VEHICLE	● EXPAND DESIGN STUDIES for LARGE ENGINES	1.5
	● INITIATE DEVELOPMENT of •LARGE TURBOPUMP and •THRUST CHAMBER	2.0
TOTAL	Estimated FY 1958 PROGRAM EXPENDITURES	16 MILLION

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